PART 5

PROCESS REQUIREMENTS

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PART 5

PROCESS REQUIREMENTS

5.0 Process Requirements:

Process, hydraulic and other plant design requirements for the 100 MLD STP and 25 MLD TTP (modular unit in the initial phase) under present Contract are described herein Part 5 – "Process Requirement".

5.1 Sewage Treatment Plants and Sewage Pumping Stations

Proposed 100 MLD STP with 25 MLD TTP (modular unit in the initial phase) shall be located on upstream of Byramangala reservoir, on the left side of Vrishabhavathi Valley as shown in the drawing. The STP will receive the raw sewage directly from the Vrishabhavathi Valley, and BWSSB will collect and convey the sewage through such Valley to an Intake chamber/distribution chamber proposed within the proposed 100 MLD STP as specified in this contract. The contractor for this contract shall construct the proposed intake chamber/ distribution chamber and coordinate the exact location and elevation of such Intake structure/ distribution chamber with BWSSB. BWSSB will make suitable arrangements to provide sewage from the valley at the intake structure/ distribution chamber location. However, the contractor shall be fully responsible for proper coordination to ensure proper alignments and interfaces and for proper implementation of all connections.

Designed average and peak flow for the proposed STP at Byramangala shall be 100 MLD and 200 MLD respectively.

S. No.	Zone	STP Name	Average Flows (MLD)		
			Initial Design @ Year 2029	Ultimate Design @ Year 2044	Peak Flow
1	Byramangala	Byramangala	100 MLD	100 MLD	200MLD

Proposed 100 MLD STP shall be designed and constructed with following technology:

- **Primary Clarification followed by Activated Sludge treatment with Biological Nutrient Removal (Nitrification, De-nitrification, and Phosphorus Removal) (4 stage Bardenpho Process), with Tertiary Treatment (UF), and Chlorine Disinfection, and Anaerobic Digestion with on-site Power Generation and sludge Dewatering.**

5.2 Influent Wastewater Characteristics

The influent wastewater characteristics to be used as the basis of design are listed in Paragraph 5.16 – "Design/Sizing Criteria and Other Requirements".

5.3 Effluent Quality Requirements

The effluent quality requirements to be met are listed in Paragraph 5.16 – "Design/Sizing Criteria and Other Requirements".

5.4 Dewatered Sludge Quality Requirements

Sludge quality requirements to be met are listed in Paragraph 5.16 – "Design/Sizing Criteria and Other Requirements".

5.5 Treatment Process

The main treatment process train for the STP and TTP shall consist of the major unit processes and components listed in Paragraph 5.16 – "Design/Sizing Criteria and Other Requirements". This list shall not be considered to be a comprehensive description. Contractor shall provide a complete, fully functional facility designed for proper, easy operation and to meet the stated performance requirements. This shall include any and all additional, ancillary, supporting, or other processes, components, equipment, or other items necessary to achieve these objectives, regardless of whether such items are explicitly listed in these bid documents or not.

The design/sizing criteria, minimum number of units, and other requirements for the various unit processes and components are listed in Paragraph5.16 – "Design/Sizing Criteria and Other Requirements", and in Part 11 – "Particular Mechanical Requirements" and shall be fully complied.

Preliminary Piping and Instrumentation Diagrams (P&IDs) for the STP is included in Volume 4 of these bid documents.

5.6 Demolition of or Interfaces and Tie-Ins with Existing Facilities

All existing facilities that are to be demolished shall be properly decommissioned, removed, and appropriately disposed of by the Contractor in accordance with all applicable laws, regulations, and standards. Items, components, or materials, whether buried, exposed, submerged, or otherwise, shall not be abandoned or left on site unless explicitly indicated in the Bidding Documents. For facilities that are to be eventually demolished but must remain in service until alternate or replacement facilities are constructed and commissioned, whether under this contract or a different contract, the Contractor shall ensure that the facilities are protected and remain functional until such time as the alternate or replacement facilities are constructed, tested, commissioned, and accepted by Employer.

All existing facilities that must remain in service permanently shall be protected by the Contractor such that they remain fully functional, operable, and serviceable throughout construction, testing, and commissioning of the new facilities. Contractor shall be fully responsible for installation and, if necessary, ultimate removal of any temporary facilities or connections (piping, utilities, power, controls, etc.) that may be necessary to maintain existing facilities fully operational throughout construction and commissioning. Temporary or permanent interfaces between existing and new facilities may involve making connections or "tie-ins" to existing live structures, piping, wiring, cabling, equipment or other components. Contractor shall be fully responsible for detailed design, planning, and implementation of such interfaces in a safe and secure manner.

For facilities that are to remain in service until alternate or replacement facilities are constructed and commissioned, the Contractor shall ensure that the facilities are protected and remain functional until such time as the alternate or replacement facilities are constructed, tested, commissioned, and accepted by Employer.

It is advised that the Bidders shall visit the site to identify the extent of works required to ensure functionality of units that will not be dismantled. All necessary documentation regarding the same such as planning, design, implementation programme shall be submitted as part of the Bid Submission. All costs associated shall be taken into account while making the submission.

5.7 Modular Design, Construction, and Operation for Reliability, Redundancy, Turndown, and Easy Future Expansion

The initial design capacity and the ultimate build out design capacity required are both specified in Paragraphs 5.1 for STP. This paragraph shall be read in conjunction with other relevant paragraphs and parts of the Bidding Documents.

For all components under this Contract, the capacity to be provided shall be designed and constructed using multiple, suitably sized unit process modules to ensure reliability, redundancy, and appropriate turndown for optimum capacity utilization and process efficiency. The minimum number of working and standby modules or units required for each component shall be as listed in Paragraph 5.13, STP Design/Sizing Criteria and Other Requirements and Part 11 of the Bidding Documents.

Bidder shall refer to minimum I/O requirements specified under instrumentation, control and automation requirements elsewhere in this document to provide and achieve complete auto operation of the STP and TTP with all operational interlocks.

5.8 Design of Plant Layout

The STP and TTP components shall be laid out and fully contained within the respective designated site boundaries so as to logically interface with the TSPS and Head Works as a part

of 100MLD STP and 25 MLD TTP (Modular Unit at initial phase) which is to be constructed under this Contract. The Contractor shall take full responsibility for designing, planning and programming the Works within the site

The Contractor's proposed site layout for STP and TTP shall clearly show the space allocated for all plant components, including those components and/or unit processes that are designated for future construction or installation, if any. Under this contract, the Contractor shall construct the civil works for the entire 100 MLD capacity TTP and install a 25 MLD modular Ultrafiltration (UF) system during the initial phase. Provision shall be made for installation of the balance 75 MLD (in modular units of 25 MLD each) at later stages as directed by the Engineer. All necessary setbacks and clearances from the site boundary shall be provided in accordance with statutory requirements.

All existing utilities (including water, sewer, power, or others, whether overhead or underground and whether physically located on the site or not) requiring to be relocated to accommodate the Contractor's proposed and approved site layout shall be relocated by the Contractor at no additional cost and without interrupting provision of such utility services to users and customers. Such relocations shall be fully coordinated with the Employer.

The plant layout shall adhere to the following minimum requirements, regardless of whether or not such requirements or any related components are shown in any drawings or specifically listed or described in any part of the document included in the Contract Document.

- Minimum clear distance provided to permit safe and convenient access for operation and maintenance shall be 3m between adjacent treatment units or fixed structures and 1.2m between pieces of equipment.
- Access and maintenance lay down area shall be provided adjacent to all mechanical equipment.
- All electrical equipment (except for motors) shall be located above the high flood level elevation for the site or for the effluent receiving water body, whichever is higher.
- All process units/ storage tanks shall be labeled with name, sizes and volume. Letters shall be of a size suitable for the application but shall not be less than 100mm high. Labels shall be located at 90-degree intervals at a suitable elevation.
- All plant items for mechanical, electrical and instrumentation shall be fitted with a unique name plate bearing the individual plant reference name for the plant item.
- Access facilities shall be provided for People with Disabilities; at minimum for all the locations at Finished Ground Level and Finished Floor Level.
- Admin building shall be provided with metal Elevator having capacity to carry minimum Six (6) People at a time of repted make and having service center in Bengaluru.
- Contractor shall provide bird eye view of entire plant by constructing viewing area above admin building. Further, contractor shall ensure that elevator of admin building shall terminate at bird eye view area.

- Minimum 1200mm wide continuous walkway shall be provided for walkthrough of liquid stream process units which shall start at Inlet Chamber of STP and end at Chlorine contact tank outlet channel. Crossing of this walkway with plant internal road shall be painted as "WALKWAY".
- Vehicular access shall be provided for all plant structures and utility buildings. A pedestrian access door shall be provided adjacent to each vehicle access door in a building. Vehicular routes within buildings shall be clearly marked and process equipment, pipes, cables etc. shall not be located within one (1) meter of a marked vehicular route; appropriate physical protection shall be provided for equipment, pipes, cables etc. located close to a vehicle access route to minimize the risk of damage.
- All plant internal roads and plant approach road shall be of asphalt macadam and minimum width shall be as specified in bidding document.
- All the roads shall be provided with minimum Curb radius of 3.5m unless specified otherwise.
- All roads shall be provided with RCC storm drain on either side of road and shall be designed & constructed to prevent standing water.
- All the roads shall be provided with painted concrete curb stone on both side of road with minimum concrete curb stone height as 300mm.
- Minimum 750mm of paved walkway shall be provided on either side of road which shall be 300mm above the road surface. Contractor shall propose storm drain below this walkway.
- Contractor shall ensure that all plant internal roads shall be provided with 100mm edge line marking, this shall be marked at 300mm away from curb stone on both sides of road with industrial grade paint.
- Proper drainage of the area around all the buildings shall be provided to avoid stagnation of rain water to prevent malarial conditions.
- Contractor shall appoint dedicated Architectural Engineer for developing Architectural view of complete plant, further contractor shall ensure that architectural view of all process and non-process building shall reflect the current era architecture as approved by Engineer.
- Contractor shall appoint dedicated Landscaping Engineer for developing Landscape layout of complete plant, further contractor shall ensue that landscaping view of complete plant should be pleasant and shall reflect modern landscaping practice of current era.
- Plantation & horticultural activities of landscaped area shall be properly maintained to give pleasant environment of build out campus throughout the O&M period.
- The speed limit for all vehicles within plant boundary shall be not more than 15kmph and same shall be displayed at suitable locations within plant road, at least at road intersection. Further, all the road intersection within plant shall be provided with direction boards at suitable elevation as directed by Engineer.

- Display hoarding for safety signs at suitable elevation shall be provided for both indoors and outdoors. These safety signs shall cover mandatory, prohibition, warning, emergency, fire-fighting and general notices as directed by Engineer.
- Display hoarding of painted plant layout shall be placed outside the admin building at suitable elevation as directed by Engineer.
- A Scale model of all the facilities within the plant boundary shall be displayed inside the Admin building with brief description of each unit process. Model shall be kept inside the glass box having dimensions 2.4m Length x 1.8m Width x 0.45m Height. The Model shall be placed at suitable height above the Finished Floor Level as directed by Engineer.

5.9 Design Requirements

The following design requirements shall be met for STP, TTP and Pumping Main. These requirements shall be fully met regardless of whether or not such requirements or any related components are shown in any drawings and other documents included in the Contract Document.

- All General Arrangement drawings and Piping Layouts shall be submitted in 3D format with corresponding detailed views.
- The Contractor shall perform a complete Hazardous Area Classification analysis as per IS 5572 for STP and TTP in this contract and shall submit a complete report of such analysis as well as Hazardous Area Classification Drawings that delineate boundaries of all classified areas and indicate the classification of each area. All electrical or other powered equipment, instrumentation, or components shall fully comply with all requirements of IS 5571 and latest amendments as on date of bid submission.
- All components (including but not limited to equipment such as pumps, blowers, screens, diffusers, inline devices; instruments such as flow meters, pressure monitoring equipment; and distribution and collection channels or pipes) shall be provided with appropriate isolation devices such as valves, gates, or other devices in order to allow isolation, drainage, cleaning, calibration, servicing, and maintenance of such components.
- Bypasses shall be provided around all flow meters with size greater than 300mm and other in-line instrumentation with isolation valves such that the instrument can be isolated and removed for calibration and maintenance without interrupting the flow, regardless of whether or not such bypasses are shown in any drawings included in the Contract Document. Also, all components (including but not limited to equipment such as pumps, blowers, screens, diffusers, inline devices; instruments such as flow meters, pressure monitoring equipments; and distribution and collection channels or pipes) shall be provided with appropriate isolation devices such as valves, gates, or other devices in order to allow isolation, drainage, cleaning, calibration, servicing, and maintenance of such components.
- All equipment, where necessary and particularly blowers, shall be provided with acoustic, sound-dampening enclosures to limit ambient noise during normal operation to the limits as detailed in Part 14.

- Suction air filters provided for process air blower shall capable of supply the process air that should not contain more than 0.02 mg of dust per m^3 of process air.
- Cooling arrangement shall be provided to ensure process air temperature of less than 80°C at air blower common discharge.
- Contractor shall provide back flow prevention mechanism / check valve inside each diffuser to prevent intrusion of liquid and/or solids into the diffuser and air piping under normal operating conditions of aeration system.
- All equipment shall be arranged, and buildings and structures designed to permit safe and easy access to and removal of all equipment.
- Fixed runways, lifting eyes, cranes, hoists, or other appropriate devices and means shall be provided on a minimum, to permit safe and easy removal of all equipment for maintenance or any other purpose.
- Minimum 1.5 factor of safety shall be incorporated over maximum weight to lift while selecting the capacity of any type of lifting device.
- All structures, whether liquid-holding or not, shall be designed such that they can be fully and completely drained and will not float or move when empty, because of groundwater buoyancy or any other reason. The structures shall be designed to counteract any possible floatation without the use of any type of groundwater pressure relief valves, including during construction.
- The floors of all liquid-holding structures (except bioreactor where diffusers are proposed to be installed on the floor) shall be appropriately sloped and trenches and drain sumps shall be provided at the bottoms of such slopes to facilitate complete drainage of liquid. Appropriate drain pipes and valves connected to the drain sump(s) shall be provided for all structures. Where the drain pipe connects to the structure, the top-of-pipe elevation shall be at least 150 mm lower than the lowest floor elevation for the structure. The drain piping shall be routed from the structure being drained to the Plant Drain Pump Station. For liquid-holding structures, the drain piping and fittings shall be sized such that the entire structure can be drained by gravity in no more than eight (8) hours. The Plant Drain Pumping Station, Plant Drain Pumps, and other related equipment and controls shall be designed and sized to allow draining of the structure with the largest volume from full to empty within eight (8) hours. The highest design water level (High-High Alarm) in the Plant Drain Pumping Station wet well shall be at least 300 mm lower than the lowest pipe invert elevation amongst all drain pipes connecting to the wet well.
- Non-liquid-holding areas, structures, or buildings where leakage or other wet activities can occur, whether in normal use or during maintenance, shall be provided with covered drainage channels which shall direct the spillage either to a suitable gravity drain or to a sump equipped with standard dual submersible sump pumps discharging to the Plant Drain Pump Station.
- Interceptor and containment bunds shall be provided for containment of all chemicals, fuel and wash water as a resultant from spillages and overflows. The Contractor shall take due

regard to the potential of hazardous mixing of chemicals, particularly as a result of leaks and spillages, and their drainage and containment.

- All concrete structures in contact with sewage and/or sludge shall be provided with full interior corrosion protection linings and/or coatings; this shall apply to all concrete structures in contact with any type of sewage and/or sludge anywhere in the plant including but not limited to complete works of Inlet works, Primary Sedimentation tanks, Sludge storage sumps, Channels etc.:and the interior corrosion protection linings and/or coatings shall be provided upto 1 m below the liquid level for Deaeration Zone, Anoxic zone, Aerobic zone, Post-anoxic zone, Re-aeration Zone, Final Sedimentation tanks,
- Complete (entire) chlorine contact tank including its free board and its inlet & outlet channel on a minimum shall be provided with White/Sky Blue porcelain tile- finish free from any pits or recesses to avoid accumulation of bacteria and dirt, else which might hinder to achieve desired outlet fecal coli-form.
- All channels conveying process liquids shall be of open type. RCC walkways shall be provided at all designated pedestrian crossings. Where heavy vehicle live loads intersect with channel paths, RCC platform shall be constructed to withstand the applied loads.
- Inlets into tanks, reactors, or other structures via pipes, channels, valves, or gates shall be designed such that the incoming flow does not cause any damage or excessive wear whatsoever to the structure (including corrosion protection linings and/or coatings) or any equipment in the vicinity under any hydraulic condition, including but not limited to the condition when the structure is empty.
- Walkways, flooring, hand railing, Plant, etc. shall be designed to take account of the prevailing conditions and be of corrosion-resistant materials. The Contractor's attention is drawn in particular to areas including, but not limited to Inlet Works.
- All walkways and staircase shall be provided with non-skid floor tiles of industrial grade designed for human traffic live loads and equipment load that carried on walkway. Whereas all the admin building requirements including staircase, flooring etc., shall be as specified elsewhere in this Bidding Document.
- Dedicated working area shall be provided on aeration tank for proper access, lifting and maintenance of installed mixers, valves, flow meters and pumps.
- Flooring of blower room and all type of pump house buildings shall be non-skid in nature and shall be designed to allow for Plant to be removed and stored on the flooring where required for maintenance, in accordance with the Bidding requirements and as per good engineering practice.
- Platforms, handrails/guardrails, ladders, stairs and safety chains shall be provided for proper, safe, and easy access to and/or operation of valves, gates, instruments, control panels, and other devices, equipment, or structures, as well as removal of the above items. All platforms and handrails shall be provided with toe guards of minimum 100mm width.
- RCC staircases shall be provided to all treatment plant units, flow dividing chambers and other structures to connect to the elevated RCC walkway platforms for which the height of the floor above finished ground level exceeds that in the prevailing standard.

- All piping shall be of corrosion–resistant material appropriate for the service and shall be provided with interior lining, exterior coating, and other corrosion protection as appropriate and necessary to meet the requirements for design life. All piping shall be fully and adequately supported and braced to comply with all applicable codes and standards. All supporting hardware shall also be of corrosion-resistant material. The design of pipe supports, and anchors shall fully account for static and dynamic vertical, lateral, longitudinal, and seismic loads, fluid flow, and thermal expansion. Seismic bracing thrust restraints and/or thrust blocks, and appropriate expansion joints or loops shall be provided as needed. Pipe lengths and joints shall be assembled and arranged for ease of removal in such a way that individual runs can be changed without dismantling adjacent pipes, by providing dismantling joints at regular intervals.
- All mixed liquor and sludge lines shall be provided with appropriate cleanouts and flushing arrangements for safe and easy flushing using high-pressure water of minimum 3.5kg/cm^2.
- All liquid service pipes shall be provided with appropriate means for safe and easy drainage of the pipes when not in service.
- All pipelines shall be color banded and suitably labeled with the stream designation and direction of flow to enable individual lines to be identified throughout their run. Particular attention shall be paid to the painting of each chemical line, which shall be based on type of chemical flowing in pipe.
- Particular attention shall be paid to the layout of the chemical piping, which shall be arranged without clutter and shall be functional and neat in appearance. Generally, where piping is installed in ducts, it shall be supported not less than 250 mm clear of the floor.
- All piping routed under any type of structure or equipment shall be fully and completely encased in reinforced cement concrete, with the encasement thickness beyond the outer diameter of the pipe being at least 200 mm on all sides. The encasement shall extend along the pipe length for a minimum horizontal distance of 500 mm in each direction beyond the footprint of the overlying structure or equipment or as per site condition based on approval of the Engineer.
- All piping connecting to, entering, or exiting any and all structures shall be provided with appropriate restrained flexible connections and/or joints at all such interfaces with structures to allow for differential movement between pipe and structure in all directions without stressing or breaking the pipes.
- Appropriate restrained flexible connections and/or joints shall be provided for all pipes where they connect to any and all of the following:
    - Equipment such as pumps, blowers, or inline devices
    - Valves
    - Wall, floor, or roof penetrations
- Where piping or other materials susceptible to damage from direct sunlight/ultraviolet radiation, they shall be protected from such light/radiation through the use of appropriate additives and/or coatings and shall be physically shielded from direct sunlight/ultraviolet

radiation at all times (including prior to and during installation) in their normal service location using enclosures, covers, canopies, roofs, and/or other similar means.

- High pressure water jet spray shall be provided to clean the accumulated screening material from both mechanical coarse screen and fine screens to ensure smooth operation while resume from standby to working condition and vice versa.
- For Final Sedimentation Tanks (or Secondary Clarifiers), the design shall provide for separate and independent measurement and control of the flow rate of sludge withdrawal from each individual tank. Such individual control shall be achieved through direct withdrawal of sludge from each unit using one or more dedicated pumps and feedback flow control using separate measurement of flow from each unit.
- Appropriate sampling ports and/or sampling valves shall be provided to allow easy, safe sampling of all process streams without spillage or contamination and without the need to interrupt normal operation.
- Foam, scum, fats, oil, grease, or any other floating material removed from any location in the STP shall be completely removed from the process flow path and under no circumstances returned / recycled to any location in the plant.
- All spare requirements specified for diffuser membrane, disc filter cloth, mixers and other spare parts of electromechanical equipment's shall be instantaneous. (i.e., equal amount of used spare shall be replaced with new spares to maintain the minimum spare quantity specified in bidding document) throughout the O&M period.
- While selecting any type of pump and blower, priority shall be given to higher pump/blower efficiency and lower power consumption and shall ensure that pump/blower can operate at high efficiency throughout its service life. At minimum contractor shall ensure efficiencies of pump/blower as listed below:
    - Minimum efficiency of Submersible Pumps shall be 55%
    - Minimum efficiency of Axial Tubular Pump (MLR) shall be 70%
    - Minimum efficiency of RAS Pump (Horizontal/Vertical Non-clog solid handling) shall be 65%.
    - Minimum efficiency of Centrifugal/Turbo/Tri Lobe blower shall be 90%
- The Works shall be designed and operated and maintained to minimize odours within, at the boundary of and in the vicinity of the Sites. The layouts of the Works shall take account of the prevailing wind direction and speed at different times of the year. Mature trees shall be provided around the full boundary of all sites, except for at accesses to the sites.

5.10 Hydraulic Design Requirement

A representative layout for STP and pumping station is included in Volume 3 of this Bidding Document. These drawings shall be considered representative only. In the event of any conflicts between information in the drawings and Part 5, then Part 5 – "Process Requirements" shall govern in accordance with the Priority of Documents.

Contractor shall submit self-explanatory hydraulic design calculations in editable MS-Excel format and shall ensure that the plant layouts and hydraulic profiles shall comply with the following specific and all other requirements described in the Bidding Document:

- The Contractor shall provide at STP, all necessary facilities for manual bypass of the process liquid at various locations in the flow path as indicated below. These facilities are included in this contract and shall be provided regardless of whether or not they are shown in any drawings included in the Bidding/Contract Document. They shall be fully functional in all respects and shall include any and all components necessary to safely and efficiently accomplish the intended bypass. Each bypass facility shall include, but not be limited to: (i) downward opening overflow weir installed in the appropriate channel or structure from which the bypass is to be affected, (ii) an appropriately sized buried (above ground piping will not be acceptable) pipe to carry the bypass flow from the channel or structure. An appropriately sized flow meter along with all associated components and infrastructure to automatically measure and record details of all bypass events, including but not limited to date, start time, end time, continuous flow rate data for the entire duration of the event, and a totalized volume for the event, shall be provided.
- Bypass flow arrangement at the STP at minimum following locations shall be provided which shall be sized to handle plants peak flows for respective design period as specified in the bidding document
    - At the Downstream of the Grit Chambers and upstream of Distribution chamber of Primary Sedimentation Tank (PST) to the final outfall structure by gravity.
    - At the upstream of Distribution chamber of Bioreactor to the final outfall structure by gravity.
    - At the upstream of Filters to the final outfall structure by gravity
- Location of outfall structure to discharge treated sewage shall be as directed by Engineer. However, contractor shall ensue that outfall structure shall be located nearest to the receiving water body and flow shall be discharged with cascade effect.
- Topographical survey information, benchmarks, contour maps, geotechnical/soil investigations, and effluent receiving water body high flood level (HFL) elevations for STP site and pumping main alignments are included with these Bidding Documents and/or available from the Employer on request. However, the Employer makes no guarantees or representations whatsoever regarding this information. The Contractor's use of this information shall be at his own risk. The Contractor shall independently obtain any and all site information necessary for proper planning, design, construction and operation and maintenance of all Works/components in the Contract.
- All aspects of the design of the hydraulics shall be based on sound principles and good common engineering practice typical for sewage treatment works.
- All process units shall be capable of passing the required peak sewage flows, including returned flows as specified.

- All the flows shall be evenly distributed between the numbers of process units in operation for all flow conditions.
- The hydraulic design calculations shall demonstrate the hydraulic functioning of the STP and TTP if any one of the process units were to be out of service for maintenance.
- Hydraulic calculations shall be based on the Hazen-Williams formulae for pipe and the Manning equation for open channel flow.
- Hazen-Williams co-efficient of 110 shall be considered for all liquid pipelines for gravity and pumping design.
- For all type of gravity channels, Manning co-efficient of 0.013 shall be considered in design.
- The head loss calculations in all sludge pipe work shall take account of the specific sludge characteristics for different types of sludge including the variations in viscosity arising from changes in the dry solids content and characteristics of the sludge.
- If Contractor's design of sludge line hydraulics is based on Hazen-Williams formula then, Hazen-Williams co-efficient of 60 shall be considered for all sludge piping both for gravity and pumping design.
- The division of flow between the individual treatment units shall be achieved by:
    - Non-submerged (i.e. with a positive freefall from weir invert to the water surface on the downstream side) overflow weirs followed by isolation gate.
    - Non-submerged downward opening overflow weir gates.
    - All air / sludge flow distribution shall be with automatic feedback flow control using inline flow measurement and modulated flow control valves with actuators and data input and control through PLC/SCADA.
- Sharp crested weirs with free discharge shall be used and shall be designed to include adequate provision for maintaining atmospheric pressures beneath the nappe.
- A positive free fall of at least 150mm shall be provided to upstream weir crests under peak flow conditions with all streams operational.
- All the flow distribution boxes shall be equipped with adjustable weir plate for equal flow distribution to each side of weir plate. Further, weir followed by isolation gate shall be provided for each weir side of flow distribution box.
- Weir length of flow distribution box shall be designed to give maximum 150mm of head over the weir at peak flow condition.
- SS 316 weir plate with minimum 6mm thickness shall be provided on each weir side of flow distribution box and shall be capable to adjust at least 75mm of its height unless specified otherwise.
- For flow distribution box, at least 1.5m of clear liquid height shall be provided between tip of the weir and invert level of flow distribution box, unless specified otherwise.
- Where flow distribution box receives the flow from channel, the connecting point between incoming channel and flow distribution box shall be provided with minimum 600mm of chamber followed by under flow baffle wall.

- All pipes and channels shall be provided with proper slope based on calculation. Also, design shall ensure that provided slopes shall facilitate draining of pipes and channels when required during maintenance. At minimum following slopes shall be considered in design unless specified otherwise:
    - All pipe lines carrying plant drain and scum shall be provided with minimum 1% of slope.
    - All channels carrying liquid shall be provided with calculated slope or minimum 1% of slope
    - All gravity sludge lines shall be provided with minimum 1.25% of slope
    - All below ground pumped sludge lines shall be provided with minimum 0.4% of slope.
    - Gravity flow either liquid or sludge shall not be permitted to flow against the slope.
- Bed level of all channels shall be provided with slope, Slope shall be provided either by constructing the bed level of channel as per calculated slope or by providing screeding in channel. If channel is provided with screeding to achieve slope, then a minimum 50mm thick screeding shall be considered at lowest discharge point of channel and accordingly calculated slope shall be provided to upstream side of channel. Contractor shall make a note that flat-bed level of channel without slope is not accepted.
- All corners of channel in contact with liquid shall be provided with fillet having minimum radius of 150mm. Further, change in flow path/direction of channel shall be achieved with smooth curve to avoid turbulence in flow.
- All corners of aeration basin in contact with liquid shall be provided with fillet having minimum radius of 600mm.
- All side corners in contact with liquid in chlorine contact tank shall be provided with fillet having minimum radius as specified in Process Requirement, whereas for other corners of chlorine contact tank in contact with liquid shall be provided with fillet having minimum radius of 300mm.
- All corners in contact with liquid in sludge storage tank/sump and any other storage tank/sump shall be provided with fillet having minimum radius of 450mm.
- The termination end of all the baffle walls proposed in Bioreactor and CCT shall be provided with semicircular end.
- Special care shall be taken to control turbulence, where Raw Sewage, RAS and recycle flows discharge into Bioreactor. Following design feature are illustrated to control the excessive turbulence in anoxic zone and other process unit locations:
    - Construction of the drop chimney/chamber which shall drop the flows to 600mm above bottom of tank. Further plan area of drop chimney/chamber shall be based on velocity criteria which shall be not more than 0.45m/s based on flow to be handled. Alternatively, Construction of the under-flow baffle wall across the flow path which shall terminate 450mm above the bottom of tank with 5minutes retention time based on plant average flow.

- Minimum number of subzones with physical partition to be provided in anoxic zone as indicated in Process Requirement, However, contractor shall ensure that flow path through subzones of anoxic zone shall create the long plug flow condition.
- Submersible type mixer shall be installed in each subzone of anoxic zone. Further, mixer shall be in a location where it shall create dispersion to mix and not to settle condition in flow path of each sub-zone.
- For all structures containing water or process liquid, the minimum freeboard (distance by which top of wall / bottom of slab in case of walkway or closed tank is higher than the maximum water surface level at receiving water) under one unit out of service condition for all flow condition shall be 0.5m unless specified otherwise.
- All pumps shall have flooded suction and negative suction shall not be allowed in pump selection.
- Maximum pipe flow velocity shall be not more than 1.0 m/s for all gravity flow and pump suction lines unless specified otherwise.
- Maximum pipe flow velocity shall be not more than 1.8 m/s for all pumped discharge lines unless specified otherwise.
- Calculated normal velocity (at 20°C and 1atm) of air piping shall not be more than 16 m/s.
- For channels, the maximum velocity shall be no more than 1.0 m/s
- For liquids the maximum velocity through gate opening shall be not more than 0.8 m/s unless specified otherwise.
- Maximum velocity through inlet ports of secondary clarifier shall be not more than 150 mm/s.
- The size of magnetic flow meter shall be same as that of pipe diameter unless specified otherwise.
- The minimum elevation difference between High water level and High-High water level shall be at least 300mm.
- The minimum elevation difference between Low water level and Low-Low water level shall be at least 300mm.

5.11 Plant Water System

The entire plant water requirement shall be taken from treated water storage tank and shall be used for multiple applications including but not limited to all chemical solution preparation (except for polymer), motive water system, filter backwash system, thickener dilution water (As applicable refer Process Requirement), general cleaning and flushing needs also for landscaping requirements. Further, plant water shall meet “Non-Detectable Fecal Coli-form” standards wherever it has possibility of direct or indirect human contact.

A separate overhead tank shall be provided for plant water system with required instrumentation to measure & control the tank level remotely. A pressurized plant water booster system shall be provided to supply plant water to all of the selected applications through pressurized plant water

ring main. Plant water booster system shall be designed to maintain a minimum pressure of 4.0 bar at the furthest point on the ring main from the booster set under conditions of maximum plant water in use. Pressure gauges complete with isolation valves shall be provided and fitted to all delivery lines and booster set pressure vessels.

The plant water ring main shall have hose connection hydrants as required for cleaning of principal process units and equipment. All potential points of spillage shall be provided with hose connection hydrants for washing down within buildings and areas where sludge or liquor spillage will occur. All such hydrants shall be specially identified as "Non-Drinking Water".

5.12 Potable Water System

Potable water shall be provided and used for safety showers, domestic potable needs and laboratory needs. The water system shall be designed to provide adequate water pressure for all of the above applications.

5.13 Process and Facilities Description

This Process and Facilities description is intended to provide the processes and types of facilities that the Contractor shall be required to design, construct, and operate, and apply to STP and TTP in this Contract unless specifically indicated otherwise. The Contractor shall use this description together with other specific information for STP provided elsewhere in this Bidding Document, including but not limited to Part 8, Part 11, & Volume 3 – "Drawings", all of which are integral to this Process and Facilities Description and are incorporated herein by reference. Contractor shall strictly comply with the specified treatment concept, treatment unit processes, flow configuration (connectivity between unit processes and facilities), performance requirements (such as effluent and sludge quality and equipment efficiencies), and design criteria (such as design operating conditions, various process loading rates and/or detention times, requirements for units out of operation, volumes, and dimensions where specified) such as the minimum requirements specified in the Part 8 and Part 11.

Bidder shall refer to minimum I/O requirements specified under instrumentation, control and automation requirements elsewhere in this document to provide and achieve complete auto operation of the STP with all operational interlocks.

5.13.1 Intake Structure/Distribution chamber

The TSPS receives the raw sewage directly from Vrishabhavathi Valley, BWSSB will collect and convey the sewage through such valley to an Intake chamber/distribution chamber proposed within the proposed 100 MLD STP as specified in this contract. The contractor for this contract shall construct the intake chamber/ distribution chamber and coordinate the exact location and elevation of such Intake structure/ distribution chamber with BWSSB. The contractor shall be

fully responsible for proper coordination to ensure proper alignments and interfaces and for proper implementation of all connections.

5.13.2 TSPS Inlet Chamber

For TSPS incoming sewage shall be conveyed from TSPS inlet manhole and/or collection chamber to the TSPS Inlet chamber via an appropriately sized single gravity pipe. An overflow pipe from TSPS inlet chamber shall be provided to overflow/bypass the sewage to final outfall structure Flow meter shall be installed on overflow pipe and all flow events shall be reordered through PLC / SCADA.

5.13.3 TSPS Trash, Coarse Screens and Macerator

Trash Screens followed by Coarse Screens and Macerator shall be provided in deep concrete channels immediately upstream of the TSPS wet well. An electronically controlled automatic jam removal system shall be provided in addition to the safety devices specified elsewhere in the document. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A screw conveyor with compactor positioned above ground level shall convey the screenings through a galvanized steel chute to a truck/tractor-trolley positioned at ground level.

5.13.4 TSPS Wet Well

TSPSs shall be of the wet well type with submersible pumps. Coarse-screened sewage from the Coarse Screens shall be collected via appropriately sized channels into a common channel which shall connect to the wet well. Partition requirement of TSPS wet well shall be as indicated in paragraph 5.16.1 “STP Minimum Requirements”

5.13.5 TSPS Pumps

Coarse-screened sewage shall be pumped by the TSPS Pumps to the STP Inlet Chamber as specified in the Bidding Document. Pump operation shall be automatically controlled based on wet well level and as defined in control philosophy based on pressure, flow and level interlocks to achieve complete auto operation of the system. All outlet valves shall be actuated valves and controlled from PLC based SCADA system.

5.13.6 STP Inlet Chamber

The Inlet Chamber receives sewage from the TSPS via a pumping. The Inlet Chamber shall have a minimum retention time of 30 seconds for average flow. Additionally, refer to the requirements specified in paragraph 5.16.1 for STPs that receive additional flows directly from the plant drain system.

5.13.7 Fine Screens

Fine Screens shall receive coarse-screened sewage from the STP Inlet Chamber. An electronically controlled automatic jam removal system shall be provided in addition to the safety devices specified elsewhere in the Bidding Document. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A screw conveyor with compactor positioned above ground level shall convey the screenings through a galvanized steel chute to a truck/tractor trolley positioned at ground level.

5.13.8 Vortex Grit Chambers, Grit Washers and Classifiers

A complete vortex-type grit removal facility inclusive of grit pumps and grit classifiers shall be provided. All equipment and components necessary for a fully functional system shall be provided regardless of whether or not such items are specifically listed or described in the Bidding Document. Washed, dewatered grit shall be collected in a truck/tractor-trolley positioned at ground level below the Grit Classifier discharge through a galvanized steel chute. Liquid streams from grit washers and classifiers shall be returned to the de-gritted sewage stream or to the Plant Drain Pumping Station.

5.13.9 Primary Sedimentation Tank Influent Channel and Flow Distribution Chamber

Distribution chamber included in this contract shall be designed and constructed for peak flow of 200 MLD + Recycle/return flow with 15 seconds retention time. The preliminary treated effluent shall flow by gravity from the Grit Chambers to the Flow Distribution Chamber via influent channel, from where it shall be distributed equally to each of Primary Sedimentation Tank (PST) in service through weirs and isolation gates. Appropriate isolation gates and/or valves with PLC control shall be provided to allow isolation of each basin. Adequately sized pipes from the distribution boxes to each PST shall be provided with a flushing connection with valve. A high pressure (minimum 4 Kg/cm^2 pressure) water system shall be provided with appropriate piping, pipe fittings, valves, and connections to this. RCC access platform, staircase, railing and covers over division boxes shall be provided by Contractor.

5.13.10 Primary Sedimentation Tanks or Primary Clarifier

Contractor shall provide four numbers of Primary sedimentation tanks of circular shape with scrapper mechanism. PST Tanks shall be designed for hydraulic retention time of 2 hrs. at average flow and filter backwash flow. Maximum SWD of the Sedimentation tank 3.5 m. Contractor shall ensure to achieve BOD removal efficiency of 30% and TSS removal efficiency of 55%. Solids consistency in primary sludge shall be 3%.

Sludge generated from PST shall be collected in primary sludge sump. Primary treated effluent shall flow to Aeration Basin distribution chamber by RCC NP3 pipe with drop manhole arrangement at PST.

5.13.11 Primary Sludge Sump and Pump House

Contractor shall provide Primary Sludge sump with retention time of 30 min with pump house height of 5 m. Sludge sump shall be constructed in M30 grade concrete and as per IS. Contractor shall provide submersible mixers (20 W/m^3 mixing energy required per cubic meter) to facilitate mixing of contents of sludge sump on continuous basis.

Primary Sludge shall be pumped to the Sludge Handling unit by Primary sludge pumps. Contractor shall provide three numbers (2 working and 1 standby) Centrifugal non-clog solid handling submersible Pumps of capacity 90 m^3/hr each at appropriate m head. Pumps shall be provided with VFD and flow control arrangement. The pump shall be suitable for handling sludge of 3% solids consistency.

5.13.12 Primary Scum Sump and Pump

Scum generated from each PST shall be collected through scum pit & suitable size pipes to primary scum sump with retention time of 4 hr.

Primary scum shall be pumped to the Sludge Handling unit by Primary scum pumps. Contractor shall provide two numbers Submersible pumps (1working and 1standby), each of capacity 20 m^3/hr.

5.13.13 Aeration Basin Influent Channel and Bioreactor Distribution Chamber

Primary treated effluent shall flow under gravity via RCC channel to Bioreactor Distribution Chamber for further distribution to the bioreactor tanks. Channel shall be designed for peak flow of 200 MLD.

Distribution Chamber included in this contract shall be designed and constructed for peak flow of 200 MLD + Recycle/return flow/ RAS with 15 seconds retention time. The primary treated effluent from Primary Settling Tanks or Primary Clarifiers shall flow to the Bioreactor Distribution Chamber under gravity, from where it shall be distributed equally to each of the Bioreactor tanks in service through weirs and isolation gates. Appropriate isolation gates and/or valves with PLC control shall be provided to allow isolation of each tank. Each Bioreactor Tank shall be connected to the distribution boxes through appropriately sized pipe with a flushing connection with valve. A high pressure (minimum 4 Kg/cm^2 pressure) water system shall be provided with appropriate piping, pipe fittings, valves, and connections to this. RCC access platform, staircase, railing and covers over division boxes shall be provided by Contractor.

RCC access platform, staircase, railing and covers over division boxes shall be provided by Contractor.

5.13.14 Bioreactors

Activated Sludge (AOAO / 4-stage Bardenpho) process consisting of anoxic zone followed by aerobic zone and post anoxic zone followed by re-aeration zone is required to achieve effluent TN limit. Aeration shall be with diffuser assemblies, and bioreactor shall be followed by sedimentation tanks/ clarifiers for biomass separation. Primary treated effluent shall enter the anoxic tank, where the nitrates recycled from the aerobic tank shall be denitrified with the BOD (electron donor) in the primary effluent wastewater. Wastewater from the anoxic tank shall flow into aerobic tank where the aeration will provide removal of remaining BOD and nitrification. Nitrates formed in aerobic tank shall be recycled to upstream anoxic tank for de-nitrification. A majority of the flow (200-500% of influent flow to biosystem) shall be recycled to anoxic tank through Internal Nitrate Recycle while the rest of the wastewater will flow to the post anoxic zone and re-aeration zone.

Bioreactors included in this contract shall be designed for pollution load corresponding to average flow of 100 MLD+ Recycle/Return flow. Bioreactor Basins shall have plug flow geometry. Each basin shall be physically divided by a partition wall. Number of sub zones to be provided in each of anoxic and aerobic zones as indicated in Part 8 and Part 11, Anoxic, aerobic, post anoxic and re-aeration zone interfaces shall be concrete partition walls that serve as overflow weirs. The top-of-wall weir elevation for each partition wall shall be such that the weir may be submerged under N-1 conditions but the head loss across the weir shall be not less than 75 mm under all operating and hydraulic conditions.

Anoxic and post anoxic zones shall be provided with submersible mixers which can be operated under auto mode of operation with all operational interlocks. Physical partitions are not necessary between the aerobic zones, but baffle walls with side opening are recommended. However, each aerobic sub-zone shall have a separate diffuser grid supplied by a separate air drop pipe with the air flow controlled by a separate actuated valve and measured by a separate flow meter. Special care shall be taken to ensure that the increase in aerobic zone water surface elevation caused by diffused aeration is considered in meeting this condition at the anoxic-aerobic interface. The Contractor shall provide specific hydraulic calculations to demonstrate that this condition is met, at a minimum, for minimum, average, and peak flow conditions.

5.13.15 Air Blowers and Diffuser Arrangements in Aerobic zone

The blowers for air diffuser system shall be turbo/tri lobe type, and dutypoint for blowers shall be decided on the basis of S.O.R (Standard Oxygen Requirement). Ancillaries like base frame, anti-vibratory pad, silencer, non-return valve, air filter etc. as per requirements should be included. Further, blowers shall have acoustic enclosures to ensure that the noise level at 1 m from blowers is below 80db. The blower room shall have sufficient ventilation, lighting and working space. The room shall be equipped with sufficient capacity electric hoist to facilitate

removal of blower/motor etc. for repairs. The room shall also have rolling shutter and adequate head room and enough space in maintenance bay for carrying out the repair works.

The operation of aeration system shall include PLC based SCADA control monitoring. The operation and speed of blowers shall be automatically adjusted to achieve the target Dissolved Oxygen, and power utilization for operation of blowers is optimized.

The main air header/ring main shall be in SS316 as per relevant IS. The header / ring main shall be supported on saddles at suitable intervals or shall be protected against external load and corrosion in case they are laid below ground. The header shall supply air to diffuser grids at various locations through air supply pipes. Air supply pipe above water level and below water level shall be in SS316 as per relevant standards. All under water lateral pipes shall be of SS316.

Each individual blower shall be equipped with a temperature gauge and transmitter, pressure gauge and transmitter, thermal mass flow meter and transmitter on the individual discharge header to measure the blower flow rate and the readings shall be used to analyse the blower efficiency.

The aeration system shall be equipped with high quality fine bubble PU/Silicon membrane diffusers.

Each individual blower discharge shall be provided with actuated valve in addition to the common header discharge actuated valves.

5.13.16 Mixed Liquor Recycle (MLR) Pumps

Each MLR pump / mechanism included in this contract shall be designed and constructed to recycle mixed liquor from aerobic zone to anoxic zone. MLR pumps shall be submersible type low head pumps with VFD operation. Contractor shall provide eight numbers of pumps (4W+4S) of capacity 3125 m^3/hr each, at the end of each aerobic zone. MLR flow at each tank shall be measured with flow meter and all flow events shall be recorded and controlled through PLC/SCADA.

5.13.17 Alum Dosing System

An alum dosing system shall be provided to accomplish chemical phosphorus removal. The Alum Storage, Solution Preparation and Dosing System shall be housed in Alum Storage Building complete with suitable hoist, etc. The solid alum may be stored on the first floor while the solution preparation and dosing system may be on the ground floor of building.

Alum dosing system shall be provided for adequate alum dose and 10% alum solution strength. Contractor shall provide two numbers alum dosing pumps, (1 working + 1 standby) of capacity 1600 LPH each for chemical phosphorus removal.

5.13.18 Bioreactor Basin Effluent Channel

Bioreactor basins effluent channel included in this contract shall be designed and constructed for design peak flow 200 MLD + Recycle/return/RAS flow. It shall carry mixed liquor to the Final Sedimentation Tank (FST) for solids separation.

5.13.19 Flow Distribution Chamber for Secondary Clarifier

MS pipeline shall be provided to Distribution Chamber of Final Sedimentation Tank (FST) for further distribution to each FST through weirs and isolation gates. Appropriate isolation gates and/or valves with PLC control shall be provided to allow isolation of each FST. Distribution chamber included in this contract shall be designed and constructed for peak flow of 200 MLD + Recycle/return/RAS flow with 15 seconds retention time. Adequately sized pipe from the distribution boxes to the each FST shall be provided with a flushing connection with valve. A high pressure (minimum 4 Kg/cm^2 pressure) water system shall be provided with appropriate piping, pipe fittings, valves, and connections to this. RCC access platform, staircase, railing and covers over division boxes shall be provided by Contractor.

5.13.20 Final Sedimentation Tank (or Secondary Clarifier)

Final sedimentation tanks shall be designed and constructed for the design peak 200 MLD flow + Recycle/return/RAS flow. Contractor shall provide circular shaped FSTs with scraper and scum removal mechanism.

Each secondary settling tank shall be fitted with a scum collection & removal system. The system shall be designed to minimize the volume of liquid discharged with the scum whilst providing efficient removal of the scum. Contractor shall ensure that only filtrate from the scum shall be sent to scum pit whilst collected scum shall be disposed properly.

5.13.21 Return Activated Sludge Sump and Pump House

RAS and WAS flow shall be collected in RAS sludge sump under gravity for further distribution to the respective places. RAS shall be sent to the distribution chamber of the Bioreactor Basins. WAS shall be pumped to the Sludge Handling Unit for treatment by WAS pumps. RAS Sump shall have retention time of 15 min; Pump house Height = 5 m. The sump shall be equipped with submersible mixers (minimum 6 W/m^3 mixing energy required per cubic meter) to facilitate mixing of contents of sludge sump on continuous basis.

Contractor shall provide 8 numbers RAS pumps (4 working and 4 standby) of each capacity 1042 m^3/hr. The RAS pumps shall be Non-clog Submersible Centrifugal solids handling pumps with VFD operated and flow control arrangement for return sludge line with supporting structures, chain pulley block with motorized operated travelling hoist for maintenance of pumps and motors. RAS discharge mains shall be provided with flow meter to measure RAS

flow rates. RAS shall be pumped to bioreactor distribution chamber by means of a suitably sized, RCC NP3 Pipe.

WAS discharge mains shall be provided with flow meter to measure WAS flow rates.

5.13.22 Secondary Scum Pit and Pumps

Scum generated from each FST shall be collected through scum pit & suitable size pipes to Secondary scum sump with retention time of 4 hr.

Secondary scum shall be pumped to the Sludge Handling unit by Secondary scum pumps. Contractor shall provide two numbers Submersible pumps (1working and 1standby), each of capacity 20 m^3/hr at 10 m head.

5.13.23 Disc Cloth Filters

Disc Filters included in this contract shall be designed and constructed to achieve less than 10 mg/l TSS in treated effluent from Disc Filters. Secondary treated effluent shall flow from FST to Filters via adequately sized pipeline with drop manholes arrangement under gravity. Isolation gates/ valves shall be provided to allow isolation and bypass of Disc filters. A complete disc filter facility shall be provided in under a concrete roof to filter treated effluent from FST. All equipment and components necessary for a fully functional facility shall be provided regardless of whether or not such items are specifically listed or described in the Bidding Document. A bypass shall be provided to the Filters for maintenance.

5.13.24 Ultra Filtration

The 100 MLD Tertiary Treatment Plant (TTP) is included under this contract. The Contractor shall design and construct the civil works for a 100 MLD capacity Ultrafiltration (UF) system, and install a 25 MLD modular Ultrafiltration (UF) system during the initial phase. Provision shall be made for installation of the balance 75 MLD (in modular units of 25 MLD each) at later stages as directed by the Engineer to achieve a treated effluent TSS of less than 1 mg/L. The disc filter effluent shall flow to the UF system through an adequately sized gravity pipeline with drop manhole arrangements, as required. Suitable isolation gates and valves shall be provided to facilitate isolation and bypass of the UF system. The UF system shall comprise of submerged membrane modules installed in stainless steel or FRP tanks/open basins, but inside a building. The membranes shall be low-fouling, and made of PVDF materials, with a nominal pore size of 0.01–0.04 microns. The system shall operate in dead-end or cross-flow mode with low-pressure suction filtration. Provision shall be made for air scour, and chemically enhanced backwash (CEB).

A fully automated control panel (PLC/SCADA based) shall control all operational sequences, including filtration, backwash, and cleaning-in-place (CIP). The system shall include feed pumps, backwash pumps, air blowers, CIP pumps, chemical dosing systems, pressure transmitters, flowmeters, and required instrumentation for continuous monitoring and control.

The UF shall be complete with necessary interconnecting piping, valves, instrumentation, and supports. All components shall be corrosion-resistant, and compliant with applicable standards. The system shall ensure easy membrane replacement, low energy consumption, and high recovery (>97%).

All Tanks (Feed, Backwash, Wastewater, Permeate), Buildings (Air Compressor, Chemical, UF), equipment and components necessary for a fully functional facility shall be provided regardless of whether or not such items are specifically listed or described in the Bidding Document.

5.13.25 Chlorine Contact Tanks

Four Chlorine Contact Tanks shall be provided, each tank providing 30 minutes retention time at 25 MLD average flow, thereby providing 30 minutes contact time for the entire 100 MLD average flow. Normally, 3 tanks will receive disc filter effluent of 75 MLD and one tank will receive 25 MLD of UF effluent.

Filtered effluent shall flow from Filtration units to Chlorine Contact inlet channel under gravity via adequately sized pipe from where flow shall be distributed to each Chlorine Contact Tank. Isolation gates shall be provided to allow isolation of each chlorine contact tank. The CCTs shall be fitted with all required instrumentation for measurement and analysis.

Chlorine shall be dosed into the Chlorine Contact Inlet Channel. A Chlorination Building shall be provided to house all chlorination equipment including chlorine cylinders, chlorinators, neutralization pit and all associated equipment complete. Further, an emergency Chlorine Scrubber and all associated systems and controls shall be provided to contain and neutralize any chlorine gas leaks regardless of whether or not such items are specifically listed or described in the Bidding Document. Treated effluent from each CCT shall enter into CCT effluent channel via submerged weirs provided on the outlet walls of each CCT Tank.

5.13.26 Final Treated Effluent Channel

Final treated effluent from CCT Tanks, which has been treated through disc filters, shall be discharged to the disposal point via RCC NP3 class pipeline. Pipeline shall be design for peak flow of 200 MLD. The contractor shall provide distribution chamber with necessary gates arrangement for reuse of treated water. The Contractor shall make arrangement such that in case effluent not utilized for reuse shall be discharged to final disposal point. Final point of disposal shall be decided by Engineer-in Charge.

5.13.27 Treated Water Tank

Final treated effluent from CCT Tank, which has been treated through ultrafiltration, shall be received in the treated water tank for reuse. Overflow from the treated water tank should overflow into the Final Treated Effluent Channel.

5.13.28 Sludge Treatment

Scum generated in the STP, raw sludge generated from Primary Sedimentation Tank, and secondary sludge generated from Final Sedimentation Tank shall be pumped to the Sludge Treatment Facility (i.e., sludge thickener, anaerobic sludge digester with biogas dome, digested sludge storage tank, and dewatering centrifuge) which has to be constructed under this Contract. The scum should be blended with anaerobically digested sludge before dewatering, and should not be fed to the anaerobic digesters.

5.13.29 Plant Drain Sump and Pumping Station

Each plant drain sump with pumping station included in this contract shall be designed and constructed to collect drain from various process unit within the STP such as recycles flows, disc filter backwash flows and other miscellaneous waste flows such as cleaning and wash-down flows generated in the plant, and to pump them back to the STP Inlet Chamber for treatment through the plant.

5.13.30 Plant Water Sump and Pumps

A plant water system shall be provided to meet the service water requirement. The entire plant water requirement shall be taken from outlet of CCT tanks and shall be used for multiple applications including but not limited to alum solution preparation, motive water for chlorination, general cleaning and flushing needs and for landscaping requirements. A sump of 48 cum capacity to meet the plant water requirement of a minimum of 1500 m^3/d shall be constructed with submersible pumps (1W+1S) of 125 m^3/h capacity to pump water to an independent overhead tank with columns and beams. The overhead tank shall not be constructed on any building. The water system shall be designed to provide adequate water pressure for all the above applications.

5.13.31 Bore wells

Bore Wells shall be provided for pumping fresh groundwater to storage of adequate capacity for supply to. safety showers, domestic potable needs, polymer solution preparation, and laboratory needs. The water system shall be designed to provide adequate water pressure for all of the above applications.

5.13.32 Administration, Laboratory, Maintenance, and Other Related Buildings/Facilities

An administration building with furniture (including SCADA room), a laboratory, a maintenance workshop, a storage facility, a guard house, OHT, process & electrical buildings and all related facilities shall be provided for a fully functional auto operated facility of STP as described elsewhere in the Bidding Document.

5.14 Flow Measurement

A complete flow measurement facility shall be provided at minimum locations as specified below to measure the flows at minimum 99% accuracy. All equipment and components necessary for a fully functional facility shall be provided for all flow measurement locations regardless of whether or not such items are specifically listed or described in the Bidding Document.

a) Flow measurement of raw sewage at inlet chamber of STP
b) Overflow/bypass flow measurement at Downstream of the Grit Chambers and upstream of the Primary Clarifier.
c) MLR flow measurement to each Anoxic zone
d) RAS flow measurement
e) WAS flow measurement
f) Process air flow measurement to each Aerobic zone and its sub-zones along with individual air blowers discharge and combined air flow measurement.
g) UF filtrate flow measurement
h) UF Backwash flow measurement
i) Flow measurement on common discharge line from plant drain pumping station
j) Bypass flow measurement for disc filter
k) Final effluent flow measurement at outlet of CCT
l) Flow measurement to common delivery side of Plant Water Pumps
m) Common discharge flow from each pumping station other than those mentioned above.

All the above locations shall be provided with online continuous flow measurement. Flow measurement devices shall provide instantaneous and totalized flow records and signals. Flow measurement devices shall be linked to the PLC/SCADA system to allow daily totalized flow and other flow trends to be analyzed, recorded and for control of process as specified in bidding document.

5.15 Sampling/Analysis Locations and Frequencies

The sampling locations, parameters analyzed, and sampling/analysis frequencies shall be as listed in the "Sampling/Analysis Locations and Frequencies" table in the "Sampling and Analysis" section of Volume 2, Part 16 of these Bidding documents, as a minimum.

5.16 Design/Sizing Criteria and Other Requirements

5.16.1 STP Minimum Requirements

Item/ Parameter/ Description	Units	Byramangala STP
Treatment Process Proposed		Primary Sedimentation followed by 4-Stage Bardenpho with Anaerobic Digestion and Power Generation, Ultrafiltration for part of the flow
Influent Wastewater Flow		
Avg. flow to TSPS	MLD	100
Average Flow to STP	MLD	100
Peaking Factor (PF)		2.00
Min Flow Factor		0.50
Influent Wastewater Characteristics		
pH		6-8
BOD	mg/L	280
COD	mg/L	590
TSS	mg/L	290
VSS	mg/L	246
TKN	mg/L	65
NH_4-N	mg/L	40
Total Phosphorus	mg/L	6.5
Alkalinity	mg/L as $CaCO_3$	330
Min. Sewage Temperature (Tmin)	^{O}C	24
Max. Sewage Temperature (Tmax)	^{O}C	27
Min. Ambient Temperature	^{O}C	15
Max. Ambient Temperature	^{O}C	45
Treated Effluent Quality Requirements (at outlet of Chlorine Contact Tank for Disc Filter Effluent)		
pH – instantaneous range		5.5 –9.0
BOD_5 at 20^0C	mg/L	≤10
COD	mg/L	≤50
TSS	mg/L	≤10
NH_4-N	mg/l	<1.0
N Total	mg/L	≤10

Item/ Parameter/ Description	Units	Byramangala STP
Total Phosphorus	mg/L	≤1
Residual Chlorine – min instantaneous	mg/L	>0.2 to <0.5 at CCT Outlet
Fecal Coliform	MPN/100 mL	≤100
Note: At the inlet and outlet of the sewage treatment plant online multiparameter analytical monitoring devices should be provided to monitor above all parameters.		
Treated Water Quality Requirements (at Outlet of Chlorin Contact Tank for Ultrafiltration Effluent)		
pH		6.5-8.0
Turbidity (NTU Scale), Max. instantaneous	NTU	< 2
Total Suspended Solids-TSS	mg/L	< 2
Biological Oxygen Demand -BOD	mg/L	< 2
Residual chlorine, instantaneous	mg/L	0.5 to 1.0
Fecal Coliform	MPN/100 mL	Nil (non detect)
Note: At the outlet of the Ultrafiltration system, online multiparameter analytical monitoring devices should be provided to monitor above all parameters		
Treated Sludge Quality Requirements (Dewatered Sludge)		
Sludge Quality		Anaerobically digested dewatered sludge with sludge class B
Maximum Sludge VSS/TSS	%	70%
Minimum sludge TSS (dry solids) for Sludge	% w/w	20%
STP Inlet and Outlet Hydraulic Conditions		
Receiving water body		Vrishabavathi River
Receiving water body HFL	m	783.20
Finished Ground Level of STP	m	Minimum 1 m above HFL
Finished Floor Level of STP	m	0.5 m above FGL
Minimum positive free-fall of treated effluent from outfall structure to HFL of receiving water body		0.5 m above HFL
Minimum drop from lowest invert level of incoming pipe in inlet chamber of TSPS to downstream high high water level in TSPS inlet chamber	m	0.1 m
Nominal diameter(s) of incoming gravity sewer(s) at STP – Contractor to field-verify	mm	2,000

Item/ Parameter/ Description	Units	Byramangala STP
MOC(s) of incoming gravity sewer(s) at TSPS – Contractor to field-verify		RCC NP3
Lowest incoming gravity sewer invert at STP terminal manhole/chamber – Contractor to field-verify	m	779.95
Intake structure/distribution chamber		
Min. length	m	4
Min. width	m	4
Min. depth (SWD) – Contractor to field-verify	m	2
TSPS		
TSPS Inlet Chamber		
Type	-	Rectangular or tapered
HRT at average flow	sec	30
No. of units	Nos.	1
SWD (Max.)	m	1.5
Height of structure above FGL	m	0.75
Trash Screens and Channels		
Screen type	-	J-type manual coarse bar screen
Max. Velocity through screen openings at peak flow	m/sec	1.2
Screening generation rate	m^3/ML	0.01
Total no. of units	Nos.	3
No. of units - Working	Nos.	2
No. of units - Standby	Nos.	1
SWD (Max.)	m	0.8
Minimum width of channel	m	2.0
Height of structure above FGL	m	0.75
Screen opening	mm	50
Thickness of screen bar	mm	12
Angle of inclination of screen	deg	90
Maximum head loss across screen	mm	200
Flow isolation		Through motorized isolation gates at U/S. and D/S

Item/ Parameter/ Description	Units	Byramangala STP
Coarse Screens and Channels		
Screen type	-	Multi-rake type bar screen with mechanical cleaning and auto jam removal
Max. Velocity through screen openings at peak flow	m/sec	1.2
Screening generation rate	m^3/ML	0.022
Total no. of units	Nos.	3
No. of units - Working	Nos.	2
No. of units - Standby	Nos.	1
SWD (Max.)	m	0.8
Minimum width of channel	m	2.0
Height of structure above FGL	m	0.75
Screen opening	mm	20
Thickness of screen bar	mm	12
Angle of inclination of screen	deg	75
Maximum head loss across screen	mm	300
Flow isolation		Through motorized isolation gates at U/S. and D/S
Length of the screen channel	-	Min 5 times the width of the screen channel at U/S and 2 times the width at D/S
Macerator		
Macerator type	-	Dual drum
Grinder Type	-	Channel Mounted with 2 rotating drums
Duty Rating	-	Heavy Duty
Flow (min)	m^3/Hr	4166
Total no. of units	Nos.	3
No. of units - Working	Nos.	2
No. of units - Standby	Nos.	1
SWD (Max.)	m	0.8
Minimum width of channel	m	2.0
Height of structure above FGL	m	0.75
Coarse screen effluent channel		

Item/ Parameter/ Description	Units	Byramangala STP
Type	-	Rectangular
No. of units	Nos.	1
Height of structure above FGL	m	0.75
Minimum length along flow direction	m	1.20
Flow entry to compartment of TSPS wet well	-	With compartment through individual isolation gates
Pumping Station (Wet well)		
No. of wet wells	Nos.	1
No. of compartments in each wet well	Nos.	2
Height of common wall between compartment	-	The common wall between the compartments shall be raised up to the invert level of the incoming pipe at the TSPS receiving chamber.
Min. HRT at peak flow	min	5
Min. pump submergence	m	1.5
Low-Low level difference	m	0.3
High-High level difference	m	0.3
Min. free board above High-High water level	m	0.3
Liquid depth (Operating)	m	4
Min. operating volume (per compartment)	cum	841
Height of structure above FGL	m	0.75
No. of pumps - Working	Nos.	4
No. of pumps - Standby	Nos.	4
Capacity of each pump	m^3/h	2084
Flow isolation and pump configuration in wet well compartment	-	Common motorized isolation gate shall be provided to connect two compartments of wet well such that velocity through isolation gate shall not be more than 0.8 m/sec at peak flow condition, further all pumps including standby shall be equally installed in each compartment.

Item/ Parameter/ Description	Units	Byramangala STP
Height of structure above FGL	m	0.75
STP		
STP Inlet Chamber		
Type	-	Rectangular
HRT at peak flow	sec	15
No. of units	Nos.	1
SWD (Max.)	m	1.5
Free board	m	0.5
Fine screens and channels		
Screen type	-	Multi-rake type bar screen / Step type with mechanical cleaning and auto jam removal
Max. Velocity through screen openings at peak flow	m/sec	1.2
Screening generation rate	m^3/ML	0.045
Total no. of units	Nos.	4
No. of units - Working	Nos.	3
No. of units - Standby	Nos.	1
SWD (Max.)	m	0.8
Minimum width of channel	m	2.6
Screen opening	mm	6
Thickness of screen bar	mm	12
Angle of inclination of screen	deg	40 / 75
Maximum head loss across screen	mm	300
Flow isolation		Through motorized isolation gates at U/S. and D/S
Length of the screen channel	-	Min. 5 times the width of the screen channel at U/S and 2 times the width at D/S
Fine screen effluent channel		
Type	-	Rectangular
No. of units	Nos.	1
Minimum length along flow direction	m	1.20
Vortex grit chamber		

Item/ Parameter/ Description	Units	Byramangala STP
Vortex type	-	Vortex grit mechanism with grit withdrawal system
Sp. gravity of particle	-	2.65
Dia. Of particle	mm	0.15
Minimum grit removal rate	%	90
Grit generation rate	m^3/ML	0.092
Maximum organic content in disposable grit	%	5
No. of grit chambers - Working	Nos.	min 2
No. of grit chambers - Standby	Nos.	min 1
Grit washers and classifiers	Nos.	3
Flow isolation	-	Through motorized isolation gates at both U/S and D/s of grit chamber
Free board	m	0.5
Primary Clarifier Distribution Structure		
Min No of Units		1
MOC		RCC
Min no. of branch boxes		As per bidder design
Common channel Max SWD	m	3
Common channel min freeboard	m	0.50
Primary Clarifiers		
No of units	Nos.	4
Type of Clarifier		Circular
Detention in Clarifier	hr	Min. 2
Side water depth (minimum)	m	3.5 (without sludge removal zone)
Maximum surface overflow rate at avg flow	m^3/m^2/day	50
Primary Removals and Primary Effluent Characteristics		
BOD Removal (minimum)		30%
TSS Removal (minimum)		55%
Primary Sludge		
Design TSS	% dry solids by weight	3%
Primary Sludge Sump and Pumps Station		

Item/ Parameter/ Description	Units	Byramangala STP
HRT at avg flow – Minimum	min.	30
MOC – below ground		RCC
MOC – above ground		200 mm solid concrete blocks
HRT	min.	Min. 30
Min. Height of pump house	m	5
No. of working pumps	Nos.	2
No. of standby pumps	Nos.	1
Capacity of each pump	m^3/h	90
Bioreactor (Aeration) Basin Influent Channel		
No of Streams		1
Min No of Units		1
MOC		RCC
Max. SWD	m	3
Min. freeboard	m	0.50
Bioreactor (Aeration) Basins for 4-stage Bardenpho process		
Min No of Basins		4
MOC – Structure		RCC
Minimum SWD	m	6
Minimum Freeboard	m	0.6
Minimum Total Volume	cum	43400
De-aeration Zone Sizing		
Min. Volume	cum	1400
Min. No. of Zones per Basin	Nos.	1
Mixing power	W/m^3	6
De-aeration Mixers		Refer Part-11, Volume-2
Direct pumping turnover frequency	per hr	1
Anoxic Zones		
Anoxic Zone Sizing		
Min Anoxic Volume - Total	cum	20,000
Min. no. of anoxic sub-zones per basin	Nos.	2
Mixing Power	W/m^3	6
Anoxic Mixers		Refer Part-11, Volume-2
Direct pumping turnover frequency	per hr	1

Item/ Parameter/ Description	Units	Byramangala STP
Aerobic Zones		
Aerobic zone DO (minimum)	mg/L	2
Aerobic Zone Sizing		
Min. Aerobic Volume - Total	cum	15000
Min. no. of aerobic sub-zones per basin	Nos.	2
Post-Anoxic Zone Sizing		
Min post-Anoxic Volume - Total	cum	5000
Min. no. of post-anoxic zones per basin	Nos.	As per bidder design
Mixing Power	W/m^3	6
Post-Anoxic Mixers		Refer Part-11, Volume-2
Direct pumping turnover frequency	per hr	1
Re-Aeration Zone Sizing		
Re-Aeration Zones		
Re-Aeration zone DO (minimum)	mg/L	2
Min. Re-Aeration Volume - Total	cum	2000
Min. no. of Re-Aeration zones per basin	Nos.	As per bidder design
Process Aeration		
AO–R - average (minimum net oxygen requirement - field conditions)	kg/h	1361
AO–R - peak (minimum net oxygen requirement - field conditions)	kg/h	1770
Type of Aeration	-	Diffused air
Max Alpha Factor, α	-	0.60
Max Beta Factor, β	-	0.95
Min Fouling factor, F	-	0.80
Aeration system sizing basis liquid temperature	-	Max. liquid temp
Aeration system sizing basis air temperature	-	Max. air temp
Peak SOTR	kg/hr	3714
SOTE per unit diffuser submergence at peak air flow (min to be provided and max to be used as design basis)	%/m	5.5%
Process Air Blowers		Refer Part-11, Volume-2
Process Air Diffusers		

Item/ Parameter/ Description	Units	Byramangala STP
Diffuser type	-	Fine bubble membrane, tubular or disc
Membrane material	-	PU / Silicon
Max air flow per effective area	$Nm^3/hr/m^2$	70
Min no uninstalled spare diffusers - percent of installed	%	5
Mixed Liqour Recycle Pumps		Refer Part-11, Volume-2
Bioreactor (Aeration) Basin Effluent Channel		
No. of streams		1
Min. No. of Units for 100 MLD		1
MOC		RCC
SWD	m	3
Min Freeboard	m	0.5
Process Air Blower Building		
Structure		1
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm solid concrete blocks
Process Air Blower Room		
Min Length	m	19
Min Width	m	15
Min Height	m	6
Electric Panel Room		
Min Length	m	7
Min Width	m	15
Min Height	m	4.5
Transformer Yard for Process air Blower		
Min Length	m	10
Min Width	m	7
Alum System		
Commercial alum form - design		Dry cake/brick
Dry Alum Storage		
Dry alum design storage period	days	30
Dry alum storage type		Cake/brick stacks in building

Item/ Parameter/ Description	Units	Byramangala STP
Alum Solution		
Purity of Alum	%	99
Alum Solution Strength	% w/w	10%
Alum solution design storage period	days	2
Alum Solution Tank Mixers		Refer Part-11, Volume-2
Alum Dosing Pumps		Refer Part-11, Volume-2
Chemical Building		
Min no of units		1
Min no of storey's		2
MOC - Roofs, Columns, and Beams		RCC
MOC - Side walls		200 mm solid concrete blocks
Upper Level Dimensions		
Min length	m	10
Min width	m	10
Min height	m	5.5
Lower Level Dimensions		
Min length	m	14
Min width	m	12
Min height	m	5.5
Secondary Clarifier Distribution Structure		
Min No of Units		1
MOC		RCC
Min no. of branch boxes		As per bidder design
Common channel Max SWD	m	3
Common channel min freeboard	m	0.50
Secondary Clarifiers		
No of Units	Nos.	4
Type		Circular
MOC - Structure		RCC
Max SOR at average flow	$m^3/m^2/day$	20
Clarifier SWD (Minimum)	m	3.7 (without sludge removal zone)
Max Weir loading at average flow	cum/day/m	185
Check Solids Loading Rate		

Item/ Parameter/ Description	Units	Byramangala STP
Max SLR at average flow	Kg /m^2/day	120
Return Activated Sludge (RAS) Pumps		Refer Part-11, Volume-2
Return Activated Sludge (RAS) Pumping Station		
HRT at avg flow – Minimum	min.	15
MOC – below ground		RCC
MOC – above ground		200 mm solid concrete blocks
Min. Height of pump house	m	5
No. of working pumps	Nos.	4
No. of standby pumps	Nos.	4
Capacity of each pump	m^3/h	1042
Secondary Scum Pit and Pumps		
Secondary Scum Pit		
Minimum volume	cum	60
Min free board	m	0.50
Secondary Scum Pumps		Refer Part-11, Volume-2
Disc Filtration		
Type	-	Out to In or In to Out
Model	-	As per manufacturer
Minimum number of filters	Nos.	3
Max Diameter of each filter	m	As per bidder design
Max Length of each filter	m	As per bidder design
Max Hydraulic Loading Rate at average flow (all units working)	$m^3/m^2/h$	8
Max Hydraulic Loading Rate at average flow (one unit not working)	$m^3/m^2/h$	10
Max Depth of each filter	m	5
Ultrafiltration (UF)		
Type of System		Vacuum Driven System with membrane modules submerged in process tanks
No. of Module		As per vendor
Membrane Type		Outside-In
Nominal Filtration Rate (flux) @ N	LMH	< 45
Peak Filtration Rate (flux) at N-1 and at peak flow	LMH	< 51

Item/ Parameter/ Description	Units	Byramangala STP
Water Backwashing rate		As per Membrane Manufacturer
Air Washing Rate		As per Membrane Manufacturer
Number of parallel trains	Nos.	As per bidder design
Side Water Depth (Maximum)	m	4.50
Free board	m	0.60
UF Recovery tank		As per bidder design
UF Air Scour blowers		Refer Part-11, Volume-2
Chlorine Contact Tank Inlet Channel		
Min No of Units		2
MOC		RCC
Channel width	m	3
SWD	m	3
Min freeboard	m	0.5
Chlorine Contact Tanks		
Min No of Units		4
MOC		RCC
Min HRT at peak flow	min	15
Min effective L/W ratio		40
SWD/Pass Width ratio		1
Min freeboard	m	0.5
Chlorine Contact Tank Effluent Channel		
Min No of Units		2
MOC		RCC
Min. Channel width	m	1.5
SWD	m	1.5
Min freeboard	m	0.5
Chlorine Gas Feed System		
Minimum chlorine dose	mg/L	5
Chlorine Ton Cylinders		
Min storage period	days	15
Max design withdrawal rate per 900 kg cylinder	kg/hr	6
Min no of cylinders - total		16

Item/ Parameter/ Description	Units	Byramangala STP
Min no of cylinders - manifold with automatic switching		8
Chlorinators and Chlorine Ejector		Refer Part-11, Volume-2
Chlorine Building		
Min no of units		1
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm thick solid concrete blocks
Min length	m	12
Min width	m	12
Min height	m	6.5
Administration, Laboratory, and SCADA Building		
Min no of units	Nos.	1
Number of Storeys	Nos.	3
MOC - Roof, columns, beams	-	RCC
MOC - Side walls	-	200 mm solid concrete blocks
Overall dimensions		
Min length	m	22
Min width	m	15
Min height per storey	m	4.5
Maintenance Workshop		
Min no of units	Nos.	1
MOC - Roof, columns, beams	-	RCC
MOC - Side walls	-	200 mm solid concrete blocks
Overall dimensions		
Min length	m	15
Min width	m	7
Min height	m	4.5
Guard Room (Security Room)		
Min no of units	Nos.	1
MOC - Roof, columns, beams	-	RCC
MOC - Side walls	-	200 mm solid concrete blocks

Item/ Parameter/ Description	Units	Byramangala STP
Overall dimensions		
Min length	m	3.5
Min width	m	3.5
Min height	m	3.0
Bore Well Pumps		
No of units - Working	Nos.	1
No of units - Standby	Nos.	1
Type of Pump	-	Submersible
Minimum capacity per pump	cum/hr	10
Plant Water Sump and Pump Station		
Plant Water Pump Station Wet Well		
MOC		RCC
Min operating volume	cum	48
Min operating depth	m	2.5
Plant Water Pumps		Refer Part-11, Volume-2
Min no of units - Working	Nos.	1
Min no of units - Standby	Nos.	1
Type of Pump	-	Submersible
Capacity of each pump - min	cum/hr	125
Min pump efficiency within flow-head operating envelope		0.70
Min motor efficiency		0.92
Mechanical Thickener Building with MCC		
Min no of units	Nos.	1
Number of Storeys	Nos.	2
MOC - Roof, columns, beams	-	RCC
MOC - Side walls	-	200 mm solid concrete blocks
Overall dimensions		
Min length	m	10
Min width	m	9
Min height of 1st storey	m	5.5
Min height of 2nd storey	m	6.5
Thickener Feed Sludge sump and Pump house		
MOC – below ground	-	RCC

Item/ Parameter/ Description	Units	Byramangala STP
MOC – above ground	-	200 mm solid concrete blocks
HRT	min	Min. 60
Min. Height of pump house	m	4.5
Thickener Feed Sump Mixers		Refer Part 11
Thickener Feed Pumps		
No. of working pumps	Nos.	4
No. of standby pumps	Nos.	1
Capacity of each pump	m^3/h	50
Mechanical Thickeners		
Mechanical thickener operation schedule	hr/day	16
	days/week	7
Min. no of working thickeners	Nos.	4
Min. no of standby thickeners	Nos.	1
Solids capture in mechanical thickener	%	95
Sludge consistency	%	5
Polymer System for Mechanical Thickener		
Poly dosing rate	kg/T of solids	2.5
Dry polymer storage		
Type	-	Covered bin
MOC	-	GRP/HDPE
Min. storage period	days	30
Storage safety factor	-	1.5
Dry polymer feed		Refer Part-11, Volume-2
No of units	Nos.	3
No. of working units	Nos.	2
No. of standby units	Nos.	1
Batching period	days/batch	1
Polymer Batch Tank Mixer		Refer Part-11, Volume-2
Polymer Metering Pumps		Refer Part-11, Volume-2
Thickened Sludge Sump and Pump house		
MOC – below ground	-	RCC
MOC – above ground	-	200 mm solid concrete blocks
HRT	min	Min. 60

Item/ Parameter/ Description	Units	Byramangala STP
Min. Height of pump house	m	4.5
Thickened Sludge Sump Mixers		Refer Part 11
Digester Feed Pumps		
No. of working pumps	Nos.	1
No. of standby pumps	Nos.	1
Capacity of each pump	m^3/h	30
Anaerobic Digesters		
Min. no. of units	Nos.	3
Digestion process		Mesophilic single-stage and single phase
Digester type		Sludge Removal from bottom
Bottom shape		Conical
Minimum bottom slope		1 in 6
MOC		RCC with full internal epoxy
Minimum HRT with all digesters in service	days	15.4
Minimum HRT with one digester out of service (N-1)	Days	12.0
Minimum volume per unit (excluding the bottom)	cum	3327
Diameter	m	21
SWD (excluding grit,scum allowance and free board)	m	12
Allowance for grit, scum, & foam accumulation	m	1
Min free board	m	1
Temperature to be maintained	Deg C	35 to 37
Digester Sludge Recirculation		Refer Part-11, Volume-2
Digester Mixing Pumps		Refer Part-11, Volume-2
Digester control building with MCC		
Total Area required	Sq.m.	330
Height (1^{st} floor)	m	5
Height (Ground floor)	m	6.5
Digester heating		

Item/ Parameter/ Description	Units	Byramangala STP
Hot water Boiler		
Min. no of units - Working	Nos.	1
Min. no of units - Standby	Nos.	1
Type	-	Flue-fire-Tube Vacuum Hot water Boiler
Digester design temperature	Deg C	37
Max. boiler operating schedule	hr/day	20
Min. boiler capacity required per unit	-	As per bidder design
Fuel	-	Primary- Digester biogas, Secondary – Heavy oil
Heavy oil storage tank		
Min. no of units	Nos.	2
Type	-	Above ground steel oil tank
Min. storage period	days	5
Max. operating schedule	hr/day	20
Min. storage capacity required per unit	-	As per bidder design
Heat Exchanger		
No. of units - Working	Nos.	3
Type	-	Tube in Tube
Max. operating schedule	hr/day	20
Min. heat transfer capacity required	-	As per bidder design
Min. required heat transfer area	-	As per bidder design
Hot water re-circulation pumps		As per bidder design
Floating Gas-Holder Cover		
Type	-	Dual membrane
Min. storage capacity	% of daily	25
Bio Gas Scrubber		
Min no of units - Working - Entire System	Nos.	1
Min no of units - Standby - at a minimum for NaOH dosing pumps, NaOH re-circulation pumps, water re-circulation pumps, and blowers	Nos.	1
Type	-	Two stage caustic scrubber with mist and flame trap
Required capacity - minimum	cum/hr	375

Item/ Parameter/ Description	Units	Byramangala STP
Maximum H_2S in outlet gas	ppm	150 or lower as required by boiler/engine generator manufacturer
Gas Engine		
Gas Engine Generator Set		
Required heat recovery	-	Engine and fuel gas cooling
Min. gas engine efficiency for electricity generation	%	35
Nominal generator capacity	kW	900 (1W+1S) / 450 (2W+1S)
Gas generation building and electrical panel		
Min. Length	m	10
Min. Width	m	8
Min. Height	m	6
Gas feed and utility blowers room		
Min. Length	m	10
Min. Width	m	5
Min. Height	m	5
Gas collection blowers room		
Min. Length	m	15
Min. Width	m	5
Min. Height	m	5
Biogas flare		
Type	-	Burner with flare, pilot burner, ignition system complete
Min. no. of units	Nos.	1
MOC	-	Epoxy coated MS with SS316 flare tip
Min. capacity per unit	cum/hr	375
Diameter	mm	100
Height	m	12
Ignition	-	Electronic
Centrifuge Feed Sump & Pump		
MOC – below ground	-	RCC
Min. HRT	hr	6

Item/ Parameter/ Description	Units	Byramangala STP
No. of pumps - working	Nos.	1
No. of pumps - working	Nos.	1
Capacity of each pump	cum/hr	40
Dewatering Centrifuge		
Centrifuge operation schedule	hr/day	16
	days/week	7
Min. hydraulic capacity	cum/hr	40
Min. no. of working	Nos.	1
Min. no. of standby	Nos.	1
Type	-	Solid-bowl
Max. input TSS	% w/w	5
Min. dewatered sludge solids concentration	% w/w	20
Min. solid capture required	%	95
Polymer System for Dewatering Centrifuge		
Poly dosing rate	kg/T of solids	5
Dry polymer storage		
Type	-	Covered bin
MOC	-	GRP/HDPE
Min. storage period	days	30
Storage safety factor	-	1.5
Dry polymer feed		Refer Part-11, Volume-2
No of units	Nos.	2
No. of working units	Nos.	1
No. of standby units	Nos.	1
Batching period	days/batch	1
Polymer Batch Tank Mixer		Refer Part-11, Volume-2
Polymer Metering Pumps		
Type	-	Hydraulic double diaphragm
No. of working units	Nos.	1
No. of standby units	Nos.	1
Min. capacity of each pump	LPH	3000
Dewatering Centrifuge building		
Min no of units		1

Item/ Parameter/ Description	Units	Byramangala STP
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm thick solid concrete blocks
Min length	m	26
Min width	m	12
Min height (1st floor)	m	6.5
Min height (Ground floor)	m	5.5
Substation for Digester		
Min no of units		1
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm thick solid concrete blocks
Min length	m	15
Min width	m	7
Min height	m	4.5
Transformer yard for Digester		
Min length	m	10
Min width	m	7
Substation for TSPS		
Min no of units		1
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm thick solid concrete blocks
Min length	m	15
Min width	m	7
Min height	m	4.5
Transformer yard for TSPS		
Min length	m	10
Min width	m	7
Substation for STP		
Min no of units		1
MOC - Roof, columns, beams		RCC
MOC - Side walls		200 mm thick solid concrete blocks
Min length	m	22

Item/ Parameter/ Description	Units	Byramangala STP
Min width	m	7
Min height	m	4.5
Transformer yard for STP		
Min length	m	10
Min width	m	7
DG (Outdoor)		
Min no of units		1
MOC		RCC
Min length	m	30
Min width	m	12
Cubicle metering + RMU		
Min no of units		1
Min length	m	10
Min width	m	5
Car Parking		
Min no of units		1
Min length	m	10
Min width	m	5

Note:

1. Bidder to maintain minimum total combined volume (Deaeration, Anoxic, Aerobic, Post anoxic and Reaeration) as specified in the above Table. However, the bidder can design the volume of each basin as per his design to meet the required effluent quality.
2. Part – 5 (Process Requirement) will be prevailing over Part-11 (Particular Mechanical Requirement) for process related requirement.
   Part – 11 (Particular Mechanical Requirement) will be prevail over the General Mechanical Specification.
3. All the liquid stream drain shall be sent to Plant drain sump by gravity. Draining of Bioreactor (Aeration) basin (MLSS liquid) shall be carried out through portable pumps and sent back to other working bioreactor (aeration) basins.
4. Drained sludge from Primary & Secondary Clarifier shall be sent to Thickener.
5. Drained supernatant from Primary & Secondary Clarifier shall be sent to Plant drain sump by gravity.

End of Part 5